UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JUL 18 2018

REPLY TO THE ATTENTION OF:

Mr. Douglas Louks Chief
Underground Storage Tanks Branch
Office of Land Quality
Indiana Department of Environmental Management
100 North Senate Avenue
Indianapolis, Indiana 46202

RE: The Indiana Department of Environmental Management (IDEM) Quality Assurance Program Plan (QAPP) for The Leaking Underground Storage Tanks (LUST) Program.

Dear Mr. Louks:

The U.S. Environmental Protection Agency, Region 5, Land and Chemicals Division, (LCD), has carefully reviewed the IDEM's Quality Assurance Program Plan (QAPP) as it applies to the Indiana Department of Environmental Management, Office of Land Quality, for its Leaking Underground Storage Tanks (LUST) Program.

A review team recommended that your QAPP be accepted and approved. Accordingly, I am pleased to approve your QAPP for a three-year period beginning June 30, 2018.

The QAPP should be updated annually and reviewed by the end of each approval period by IDEM and LCD's Technical Contact and Quality Assurance Coordinator to accommodate any changes in the program.

Please feel free to contact me, or your staff may contact Dr. Larisa Leonova, CMB's QA Coordinator, at (312) 353-5838 to discuss any issues related to our review and approval.

Sincerely,

Julie Morris, Acting Chief
RCRA Branch

Enclosure

Investigation of Underground Storage Tank Releases

Office of Land Quality
Underground Storage Tank Branch

Quality Assurance Program Plan

B-001-OLQ-UST-LST-18-Q-R3
June 30, 2018

Office: Office of Land Quality (OLQ)

Branch: Underground Storage Tank Branch

Section: Underground Storage Tanks, Leaking Underground Storage Tanks

Effective date: Upon United State Environmental Protection Agency (U.S. EPA) Approval

Date revised: June 30, 2018

Revision #: 3

Review cycle: Three Years (expires June 30, 2021)

QAPP Summary:

This Quality Assurance Program Plan (QAPP) outlines the quality requirements for the Investigation of Underground Storage Tank (UST) Releases. The program activities are supported by U.S. Environmental Protection Agency (U.S. EPA) Region 5 through a cooperative agreement with the Indiana Department of Environmental Management (IDEM).

Indiana Department of Environmental Management
Indiana Government Center North
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EPA Approvals

Julie Morris, U.S. EPA Region 5
Acting Chief, RCRA Branch

7/16/18
Date

Sherry Kamke, U.S. EPA Region 5
Chief, Underground Storage Tanks Section,
RCRA Branch

7/16/2018
Date

Larisa Leonova, U.S. EPA Region 5
Quality Assurance Coordinator,
Chemical Management Branch

7/16/2018
Date

IDEM Approvals

Peggy Dorsey, Office of Land Quality IDEM
Assistant Commissioner — Date: 7/12/18

Amy Smith, Office of Land Quality IDEM
Deputy Assistant Commissioner — Date: 6/26/2018

Douglas Louks, Office of Land Quality IDEM
Chief, Underground Storage Tanks Branch — Date: 06/26/2018

Laura Steadham, Office of Land Quality IDEM
Chief, Science Services Branch — Date: 26 JUN 2018

Tim Veatch, Office of Land Quality IDEM
Chief, Leaking Underground Storage Tanks Section — Date: 7/12/2018

Tom Newcomb, Office of Land Quality IDEM
Chief, Underground Storage Tanks Section — Date: 6-26-2018

David Harrison, Office of Land Quality IDEM
Science Services Branch QA Coordiantor — Date: 6/26/'18

IDEM Quality Improvement Staff — Date: 6-26-2018

Table of Contents

Tables and Figures

Introduction

The U.S. EPA, through Chief Information Officer 2106.0 October 21, 2008 (Appendix A, #1) reaffirms and establishes requirements for the agency's mandatory quality system. Because Underground Storage Tank (UST) activities include environmentally-related measurements or data generation, IDEM is required by U.S. EPA regulations (40 CFR Part 31.45) to develop and implement a quality assurance system. This resulting QAPP for the IDEM's Office of Land Quality (OLQ) has been developed pursuant to:

- *U.S. EPA Requirements for Quality Assurance Project Plans (QAPPs)* (QA/R-5), U.S. EPA/240/B-01/003, March 2001 (Reissued May 2006); (Appendix A, #8)
- *U.S. EPA Guidance for QAPPs,* (QA/G-5), U.S. EPA/240/R-02/009, December 2002; (Appendix A, #7) and
- *IDEM Agency Wide Quality Management Plan*, IDEM, May 1, 2018 (Appendix A, #5)

A. Program Management

A.1 Distribution List

The Quality Assurance Program Plan (QAPP) will be available via a link on IDEM's Leaking Underground Storage Tank web site. (Appendix A, #5). It will also be electronically distributed to the staff in the Underground Storage Tank (UST) Branch and Science Services Branch (SSB). A copy will be provided to the US EPA Region V.

U.S. EPA Region 5

- Chief, Program Management Branch
  - Gary Victorine, (312) 886-1479
- Regional Program Manager
  - Sherry Kamke, (312) 353-5794
- State Program Officer
  - Estelle Patterson, (312) 886-3594
- QA Manager
  - Larisa Leonova, (312) 353-5838

IDEM

- Assistant Commissioner, Office of Land Quality (OLQ)
  - Peggy Dorsey, (317) 234-0337
- Deputy Assistant Commissioner, OLQ
  - Amy Smith, (317) 234-0892
- Chief, Underground Storage Tank Branch
  - Douglas Louks, (317) 234-5344
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  - Tim Veatch, (317) 234-0980
- Chief, Underground Storage Tank (UST) Section
  - Tom Newcomb, (317) 234-0357
- QA Coordinator, Underground Storage Tank Branch
  - Jason Goulet, (317) 234-5064
- Chief, Science Services Branch (SSB)
  - Laura Steadham, (317) 232-8866

- Chief, Chemistry Services Section
    - Steve Buckel (317) 232-5884
- Chief, Engineering and GIS Services Section
    - Barry Steward (317) 232-8929
- Chief, Geological Services Section
    - Jeff Bahling (317) 234-0991
- Chief, Risk Services Section
    - Susan McKinley (317) 232-4419
- Science Service Branch QA Coordinator
    - David Harrison, (317) 232-8877
- All Project Manager (PM) staff positions as follows:
    - Doug Bartz, (317) 695-6170
    - Steve Baumann, (219) 464-0233
    - Jill Berry, (317) 234-0981
    - Jake Duman, (317) 234-4793
    - Darrin Egbert, (317) 234-6825
    - Meghan Flaherty Ruhl, (317) 234-0978
    - Rosy Hansell, Marion County Health and Hospital Corp., (317) 234-0985
    - Lynsie Harper, (317) 234-4204
    - Shay Hartley, (317) 234-5160
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    - Kay Ifekoya, (317) 232-7205
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    - Jason Murdoch (317) 234-9561
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    - Greg Waltz, (317) 233-1513
    - Robyn Weaver, (317) 234-8119
- LUST Administrative Staff
    - Roberta Ellis, (317) 232-8900
    - Sherry Jordan, (317) 233-1519
    - Angela Stewart, (317) 233-5745
- Assistant Commissioner, Office of Program Support (OPS)
    - Julia Wickard, (317) 234-3386
- Recycling Education, and Quality Assurance Manager
    - Pat Daniel (317) 234-6562
- IDEM Quality Assurance Staff
    - Dav Parry (317) 233-4638

A.2 Program Roles, Responsibilities, and Organization

IDEM is the State agency authorized to manage environmental issues and conditions in the State of Indiana. The State of Indiana applied for approval of the underground storage tank (UST) program under U.S. EPA Subtitle I of the Resource Conservation and Recovery Act (RCRA) (Appendix A, #2); this approval was granted by the U.S. EPA, effective July 12, 2006, authorizing IDEM to operate the State UST Program in lieu of the Federal UST program. UST Owners are required to follow applicable Indiana Statutes (13-23), Indiana Administrative Code (329 IAC 9), and IDEM guidance.

The UST Branch data review is supported by the IDEM SSB. Chemists, Engineers, GIS Data Services, Geologists, and Risk Assessors review the submitted data to determine if the information was collected and analyzed satisfactorily.

An organizational chart for the IDEM Programs is provided in Figure 1, and the roles and responsibilities as they pertain to this QAPP are described in the narrative below.

- **OLQ Assistant Commissioner (AC):**
  - Communicates needs with IDEM Commissioner
  - Oversees all OLQ Operations.
  - Approves the Investigation of Underground Storage Tank Releases *QAPP*.
- **OLQ Deputy Assistant Commissioner (DAC):**
  - Oversees the Science Services Branch and UST Branch Operations.
  - Approves the Investigation of Underground Storage Tank Releases *QAPP*.
- **UST Branch Chief (BC):**
  - Oversees all UST Branch Operations.
  - Approves the Investigation of Underground Storage Tank Releases *QAPP*.
- **UST Branch QA Coordinator:**
  - Reviews and updates the Investigation of Underground Storage Tank Releases *QAPP.*
  - Provides technical support to the Branch Chiefs, Section Chiefs, and program staff.
- **LUST Section Chief (SC):**
  - Oversees LUST staff review of owner/operator compliance with statutes, rules, guidance, SOPs, and Investigation of Underground Storage Tank Releases *QAPP*.
  - Approves site closure documentation, typically in the form of 'No Further Action' letters.
  - Approves the Investigation of Underground Storage Tank Releases *QAPP*.
- **LUST Section Project Managers (PM):**
  - Evaluate owner/operator compliance with UST Program statutes, rules and regulations.
  - Coordinate and compile the technical review of documents by IDEM Science Services Branch.
  - Analyze site specific Conceptual Site Models (CSM) and determine next steps;
  - Write owner/operator site correspondence.
  - Maintain site-specific records and update IDEM's databases.

- **UST Section Chief/UST Closure Coordinator:**
  - Inspect UST closure activities and sampling.
  - Evaluate owner/operator compliance with UST Program statutes, rules, and regulations.

IDEM OLQ Science Services Branch Roles and Responsibilities

The following roles provide technical evaluation services for the UST Program:

- **OLQ Science Services Branch (SSB) Chief:**
  - Ensures SSB compliance with Indiana Statutes, Indiana Administrative Code, IDEM Guidance, QAPPs, SOPs, and Work Summaries.
  - **OLQ Chemists:**
    - Provide review, verification, and validation of data generated for the UST Program.
    - Evaluate project goals, sample collection documentation review, analytical methods, data reviews and data acceptability on the basis of analytical data results, laboratory Quality Assurance/Quality Control (QA/QC), sampling reports, and procedures.
      Site specific sampling data:
      - Completed chain of custody with sample date, time, signature, and identification
      - Map or diagram of sample locations
      - Sample field sheets that document sample identifiers, locations, date and time, sampling methods and equipment, samplers, calibration methods, and any notable observations (color, clarity, texture, reactions with preservatives, etc.)
      - Blanks – trip, field, or equipment rinsate blanks, as appropriate
      - Identity of field duplicates – typically at least one per twenty samples per matrix for each method
      - Adequate sample volume
      - The following laboratory-related items should support every investigation:
      - Completed chain of custody with signature, date, and time of receipt
      - Condition of samples on receipt
      - Sample identification – site identification and lab identification
      - Sample handling
      - Sample preparation logs with extraction, cleanup or digestion details
      - Certificates of analysis with method, analysis date, results, method detection limits, reporting limits, and any dilution factors
      - Case narrative detailing any deviations, problems, and corrective actions.
      - If the purpose of sampling is a stand-alone assessment of the vapor intrusion pathway, IDEM recommends U.S. EPA Methods TO-14A, TO-15, or TO-15 SIM (all canister-based methods) and use of a fixed laboratory when analyzing air, soil gas, or sub slab gas samples. The following sampling-related items should support every vapor intrusion investigation:

- Field records of the initial and final canister pressures, start and stop times for canister filling, and approximate fill rates • Field measurement records (ambient temperature and pressure, screening results)
- Records of any leak tests performed
- Documentation of canister cleaning (batch or individual certification)
- Copy of a completed Indoor Air Building Survey Checklist (RCG Appendix IV or similar)

- Evaluate background samples
- Review Investigation of Underground Storage Tank Releases Quality Assurance Project/Program Plan (QAPP).

- **Geographic Information System (GIS)/Data Services Personnel:**

  - Provide technical support as required, including: geographic positioning system (GPS) data, GIS mapping, and electronic data submission and storage.
  - Verify legal property descriptions for Environmental Restrictive Covenants.

- **OLQ Geologists:**

  - Provide technical review services, including: report review, sample collection review, evaluation of proposed remedy options, evaluation of plume behavior, and appropriateness of engineering and institutional controls.

- **OLQ Engineers:**

  - Evaluate effectiveness and design of remediation systems.

- **OLQ Risk Assessors:**

  - Provide technical support for LUST sites seeking risk-based closure.
  - Evaluate potential exposure pathways.

Owner/Operator and Consultant Roles and Responsibilities

- Complies with UST Program applicable Indiana Statutes (13-23), Indiana Administrative Code (329 IAC 9), and IDEM guidance.

Figure 1: IDEM Management Organizational Chart

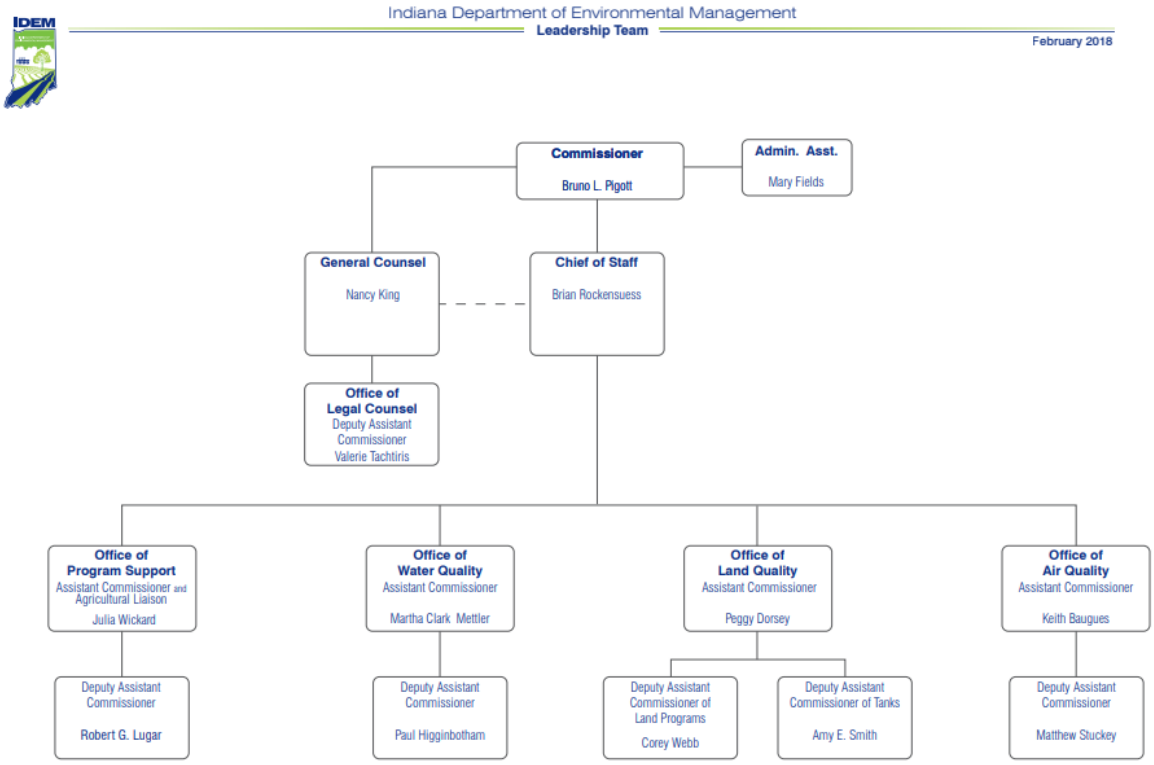


Figure 2: Office of Land Quality Branches and Sections (IDEM QMP, Appendix 5)

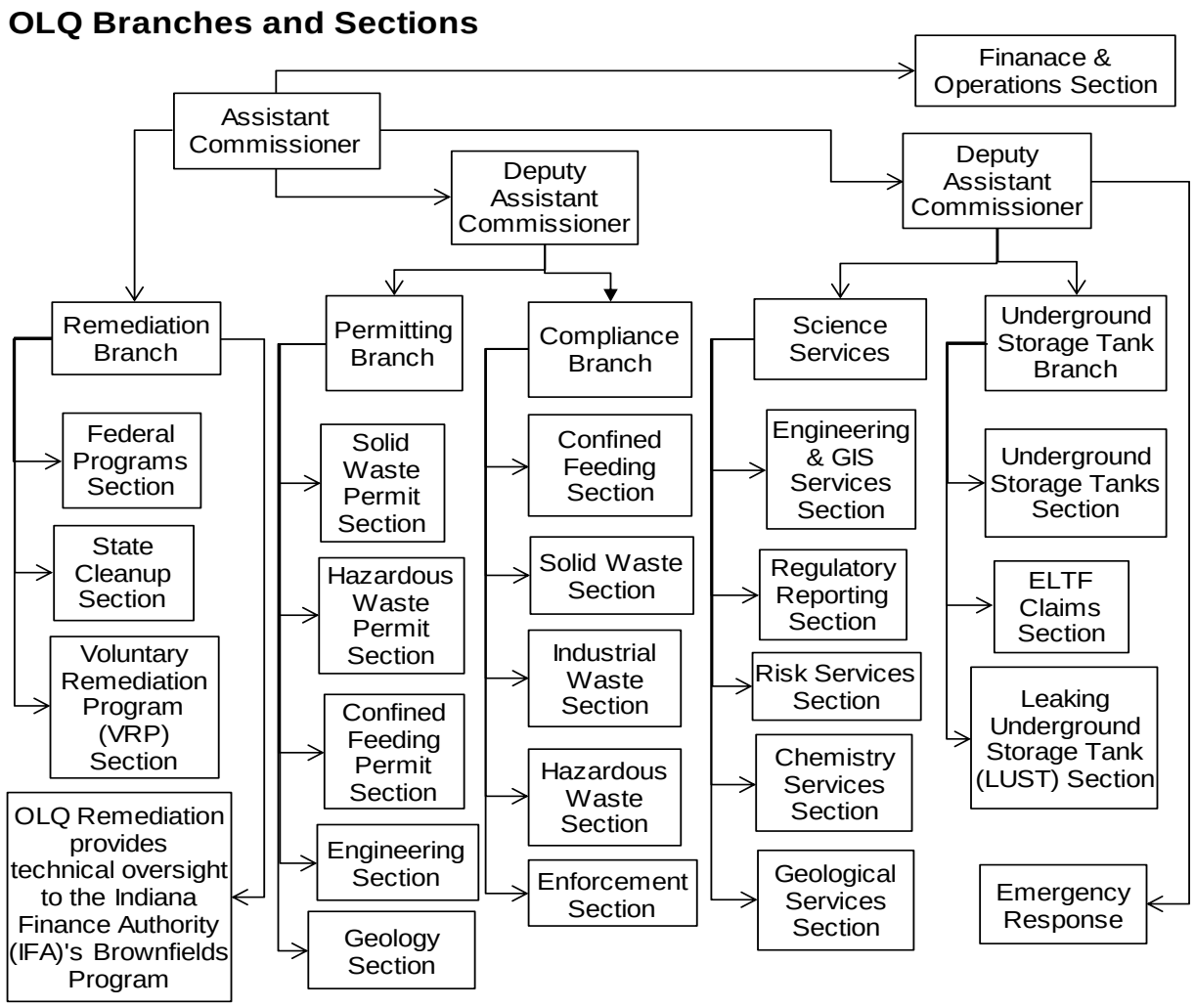
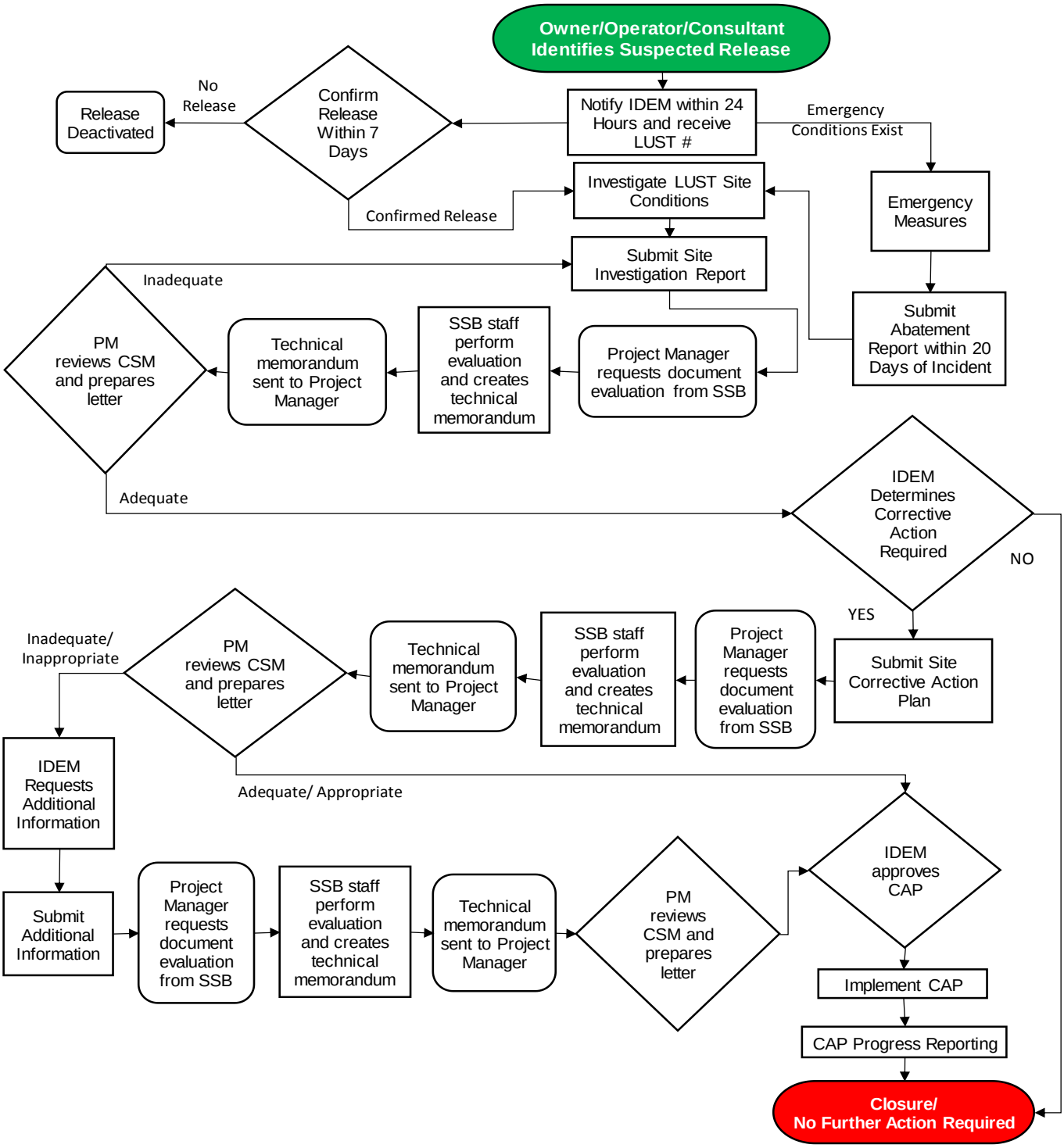


Figure 3: Document Flow Between the OLQ Underground Storage Tank and Science Services Branches



A.3 Problem Definition/Background

IDEM's mission statement is to implement federal and state regulations to protect human health and the environment while allowing the environmentally sound operations of industrial, agricultural, commercial and government activities vital to a prosperous economy.

IDEM's OLQ utilizes a risk-based corrective action approach to assess and remediate UST releases. The *Remediation Closure Guide* (Appendix A, #3) describes how to achieve consistent closure of contaminated media by documenting:

- How to assess contamination present at a site;
- How to evaluate and mitigate potential exposure pathways to contamination;
- Options for determining risk-based site closure levels, remedy selection and implementation;
- How to achieve closure (No Further Action) status and;
- The use of institutional controls as a closure option to manage residual contamination and exposure risk.

A.4 Program Task Description

IDEM has approximately 4,100 active UST sites to manage across the State of Indiana. On average approximately 150 LUST incidents are reported each year.

Within the UST Program, the number and type of tasks required may vary based upon site characteristics. Each completed task may lead to a request for additional investigation, corrective action, or a consideration of a 'No Further Action' (NFA) status from IDEM. In general, the project tasks for the UST Program may be broken into 3 major categories: 1) Notification and response tasks for suspected or confirmed releases, 2) Investigation tasks for potential or confirmed releases, and 3) remedial strategy, risk assessment, and closure tasks.

Tasks within these categories are summarized in Table I, and include references to sources where additional information may be found as well as project schedule dates. These three categories make up the conceptual site model (CSM).

The CSM is an iterative "living" representation of a contaminated site (or property) that provides a simplified and concise summary of contamination sources and distribution; release mechanisms; exposure pathways and migration routes; and human and ecological receptors (U.S. EPA, 2011). As required by U.S. EPA's systematic planning process for the collection and evaluation of environmental data (U.S. EPA, 2006), development of a CSM is an integral step in clarifying cleanup objectives for a site and determining appropriate data quality objectives (DQOs). (IDEM Technical Guidance on CSM's Appendix A, #14)

Table 1. UST Program - Releases Project Category Summary

Category	**Task**	**Description/Contents**	**Schedule**	**References for More Detail**
Notification and Response	Suspected Release/Confirmed Release	Documentation to include owner/operator details; UST system description; description of suspected release.	RPs notify IDEM within 24 hours; 7 days for RP to confirm release or no release	329 IAC 9-4, 329 IAC 9-5-2
Notification and Response	Mitigation and Free Product (FP) Abatement	Documentation of vacuum events; vapor mitigation; occupant evacuation; alternate water supply provision; interceptor trench; booms in surface water; product recovery efforts; etc.	Reports due 20-days (mitigation) OR 45 days (FP Recovery) from date of notification to IDEM	*329 IAC 9-4-1*; 329 IAC 9-5-3.2
Investigation	UST Closure Report	Report provides the details of UST closure, including sampling results that may or may not indicate a release from the UST system. Required for removal, closure in-place, and change of service.	Within 30 days of UST decommissioning or closure	*329 IAC 9*-6
Investigation	Initial Site Characterization (ISC)	Initiate investigation to define nature and extent of contamination and evaluate exposure pathways and receptors, evaluate remediation alternatives.	Within 60 days of release confirmation	329 IAC 9-5-5.1
Investigation	Further Site Investigation (FSI)	Further investigation if ISC fails to define nature and extent of contamination; evaluation of remedial alternatives.	Due as directed by IDEM for additional site investigation after the submittal of the ISC.	*329 IAC 9-5-6*
Remediation, risk assessment, and closure	Corrective Action Plan (CAP)	Plan describing remedial strategy for site.	Due as directed by IDEM 60-90 days from request for CAP; must include progress milestone timetable.	329 IAC 9-5-7.
Remediation, risk assessment, and closure	Corrective Action Plan Progress Report	Required for: 1) When requested by IDEM prior to corrective action; 2) Corrective action monitoring; 3) Monitored natural attenuation or other closure monitoring such as plume stability demonstration.	Quarterly, or as documented in approved CAP	329 IAC 9.5.7
Remediation, risk assessment, and closure	Request for No Further Action	Documents justification for closure decision, including risk assessment.	After successful implementation of CAP and cleanup objectives achieved	329 IAC 9.5.7

A.5 Quality Objectives and Criteria

A.5.1 Data Quality Objectives (DQOs)

DQOs are qualitative and quantitative statements that clarify the study objective and define the appropriate type of data to collect. The DQO process results in the full set of specifications needed to support the qualitative and quantitative design of a data collection effort. DQOs are also used to assess the adequacy of data in relation to their intended use.

The US EPA's Guidance on Systematic Planning Using the Data Quality Objectives Process EPA/QA –G-4 (Appendix A, #20) indicated the seven steps to the DQO Process. The approach to each step for IDEM's UST Program are described below.

Step 1: State the Problem

A release or suspected release from a regulated UST has been identified.

Step 2: Identify the Decision

There are five main decision statements to consider:

- Decision Statement I - *A release of petroleum or hazardous substance potential contaminants from an UST system has been confirmed.*
- Decision Statement II – *The release presents an immediate threat to human health or the environment (e.g., fire, explosion, chemical burns, and vapor hazards) and requires accelerated response activities. Sites that present an immediate health or environmental threat will undergo additional accelerated response requirements.*
- Decision Statement III – *The areal extent of the release above the screening levels has been delineated and lists of potential exposure pathways and potential exposure scenarios are identified.*
- Decision Statement IV – *The site contamination requires active remediation and/or the use of engineering or institutional controls.*
- Decision Statement V – *The remedial actions were performed, meet remedial objectives, and limit exposure to potential contaminants.*

Step 3: Identify the Inputs to the Decision

Groundwater and soil samples will be collected and analyzed to assess and document releases to the site media. In addition, potential exposure pathways are evaluated, and sensitive areas (e.g., surface water and well head protection areas) are identified and may be sampled. Concentrations of detected contamination in soil and groundwater will be compared to the screening levels (Sections 1.3.1, 1.3.2, and Appendix A of the *Remediation Closure Guide*). The screening levels are risk-based numerical values for each contaminant based on chemical characteristics, media concentration, toxicity, and exposure pathway.

Minimum data documentation requirements (MDDR) lab data is sufficient for most sampling information. However, IDEM staff may specifically request the full QA/QC data package on a site specific basis if necessary. Table 2 shows the requirements for both MDDR and full QA/QC data packages.

In addition to the elements in Table 1, the following sampling-related items should support every investigation:

• Completed chain of custody with sample date, time, and identification

• Map or diagram of sample locations

• Sample field sheets that document sample identifiers, locations, date and time, sampling methods and equipment, samplers, calibration methods, and any notable observations (color, clarity, texture, reactions with preservatives, etc.)

• Blanks – trip, field, or equipment rinsate blanks, as appropriate

• Identity of field duplicates – typically at least one per twenty samples per matrix for each method

• Adequate sample volume

The following laboratory-related items should support every investigation:

• Completed chain of custody with date and time of receipt

• Condition of samples on receipt

• Sample identification – site identification and lab identification

• Sample preparation logs with extraction, cleanup or digestion details

• Certificates of analysis with method, analysis date, results, method detection limits, reporting limits, and any dilution factors

• Case narrative detailing any deviations, problems, and corrective actions.

If the purpose of sampling is a stand-alone assessment of the vapor intrusion pathway, IDEM recommends U.S. EPA Methods TO-14A, TO-15, or TO-15 SIM (all canister-based methods) and use of a fixed laboratory when analyzing air, soil gas, or sub slab gas samples. The following sampling-related items should support every vapor intrusion investigation:

• Field records of the initial and final canister pressures, start and stop times for canister filling, and approximate fill rates • Field measurement records (ambient temperature and pressure, screening results)

• Records of any leak tests performed

• Documentation of canister cleaning (batch or individual certification)

• Copy of a completed Indoor Air Building Survey Checklist (RCG Appendix IV or similar)

Table 2: Elements for Minimum Data Documentation Requirements (MDDR) and Full QA/QC DQOs

Element	Method Type	MDDR	Full QA/QC
Sample introduction method (e.g., direct injection, purge-and-trap)	Specific gas chromatography (GC) detector method	✓	✓
Tuning criteria and results	Gas chromatography/mass spectroscopy (GC/MS)		✓
Initial calibration (IC) and IC verification	All		✓
Continuing calibration(s)	All		✓
Blank results (e.g., field, prep, method)	All	✓	✓
Laboratory control sample	All	✓	✓
Internal standard summary	GC/MS, GC	✓	✓
Surrogate recoveries	GC/MS, GC	✓	✓
Matrix spike/matrix spike duplicate recoveries	All (except TO-14A, TO-15, and TO-15 SIM)	✓*	✓
Interference check sample	Inductively coupled plasma (ICP) methods		✓
Serial dilutions	ICP methods		✓
Method of standard additions (if applicable)	ICP methods		✓
Raw data (instrument printouts, chromatograms, and/or mass spectra as applicable)	All		✓
Confirmation on second column (or GC/MS)	Pesticides, polychlorinated biphenyls (PCBs), benzene, toluene, ethylbenzene and xylenes (BTEX) and other VOCs by GC		✓

*Only necessary during initial and final sampling.

If site conditions warrant, evaluation of soil gas or indoor air samples may be necessary to evaluate the risk due to vapor intrusion. Soil gas and/or indoor air samples are compared to criteria in Table A-6 of the *Remediation Closure Guide*.

Step 4: Define the Study Boundaries

The spatial and temporal boundaries of each site may vary. Samples may be collected on-site or off-site as necessary to determine the nature and extent of contamination.

The owner/operator and consultant should follow U.S. EPA in recommending eight to ten or more samples for determining a background threshold value. In some cases, more than ten samples may be necessary to support a background demonstration, depending on methodology and site characteristics. Investigators should document

that the number of samples is adequate to support the selected method. Because the data evaluation process sometimes reduces the size of the set of background samples, it may be prudent to collect extra samples during the initial sampling effort. (Chapter 6 of the *Remediation Closure Guide*) (Appendix A, #3)

The owner/operator and consultant's representative background samples should come from equivalent stratigraphic positions in background reference areas comparable to the site. Suitable areas are (1) free of the influence of nearby sources of the contaminants under investigation and (2) underlain by the same soil layers as the source area. (Chapter 6 of the *Remediation Closure Guide*) (Appendix A, #3)

Step 5 and 6: Develop a Decision Rule (Develop the Analytic Approach)

Decision Rules are "if/then" statements that determine how a project will proceed by evaluating the data. Once data have been verified and validated according to Section 3.9 of the *Remediation Closure Guide* (Appendix A, #3), all useable data are evaluated to ensure that they meet the investigative criteria. Examples of decision rules are:

- Decision Rule I – If a suspected or confirmed release of one or more potential contaminants has occurred, then an incident number is generated and additional assessment is necessary.
- Decision Rule II– If the release causes an immediate threat to human health or the environment, then the appropriate response(s) to mitigate the threat must be initiated.
- Decision Rule III – If the areal extent of the released regulated substance has not been delineated, then conduct additional investigations as necessary to delineate the site and to assess pathways and receptor effects in the conceptual site model.
- Decision Rule IV– If corrective action is necessary based on the conceptual site model and IDEM review, the owner/operator must submit a Corrective Action Plan to IDEM.
- Decision Rule V– If the conceptual site model can be satisfactorily addressed with an appropriate closure strategy, the site will be eligible for No Further Action.

Step 7: Develop the Plan for Obtaining Data (Optimize the Design for Obtaining Data)

Expected spatial, sampling, and analytical variations are key inputs to designing sampling schemes for judgmental sampling.

Judgmental sampling uses professional judgment and existing site knowledge to place sample locations. Judgmental sampling works best at sites with known locations of potentially contaminated areas, receptors, or other indicators for sampling. In such cases, judgmental sampling may simplify sample placement. Therefore, sampling points near UST components (UST, piping connections, dispensers, etc.) that have previously leaked should be considered in the sampling design.

Spatial and sampling variations have been considered in the UST Program sampling design, with the result that soil sample evaluation is conducted by calculating exposure point concentrations (EPCs). Methods for deriving EPCs vary according to sampling approach. For judgmentally collected samples, the individual sample results for each potential contaminant are generally the EPCs. Where judgmentally collected samples are of sufficient density and spacing, it may be appropriate to estimate the upper confidence limit of the mean (UCL) 49 to represent the EPC. If the sampling

locations are judgmentally guided using field instruments (e.g., photoionization detector), the resulting UCL is likely to be biased high. Nevertheless, some investigators may wish to use this approach to derive a conservative EPC, particularly where a few individual sample results exceed remediation objectives. For systematically collected samples, the EPC is an appropriate UCL calculated for each potential contaminant using results from a sample array that corresponds to the area under evaluation. The resulting UCL is the EPC. For more details, refer to Section 8.4 of the *Remediation Closure Guide*. (Appendix A, #3)

A.5.2 Measurement Quality Objectives (MQOs)

Measurement quality objectives (MQOs) are "acceptance criteria" for the quality attributes measured by project data quality indicators (DQIs). (Please see section B.5) The principal DQIs are precision, accuracy (as bias), representativeness, comparability, completeness, and sensitivity (PARCCS). Data Quality Indicator (DQI) criteria apply not only to the laboratory, but also to the field sampling measurements.

The overall QA objective for the UST Program is to develop and implement procedures for sampling, contaminant selection, laboratory analysis, and reporting. The Potential Petroleum Contaminants are provide in the following table:

Table 3 Potential Petroleum Contaminants

Potential Petroleum Contaminants[1]

Petroleum Product or Waste	Soil	Ground Water	Air/ Soil Gas	Typical Products/Wastes
Gasoline Range Product	VOCs[2] Naphthalenes[3] Lead and Lead Scavengers[4]	VOCs[2] Naphthalenes[3] Lead and Lead Scavengers[4]	VOCs[5]	Automotive Gas Aviation Gas Racing Fuel Mineral Spirits Stoddard Solvent Naphtha Jet Fuel - JP-4 Ethanol fuels
Diesel Range Product	VOCs[2] PAHs[6]	VOCs[2] PAHs[6]	VOCs[5]	Diesel #1 & 2 Kerosene Jet Fuel-JP #5, 7 & 8 Light Oil Home Heating Oil Biodiesel <100%
Hydrocarbon Oils Range Product	PAHs[6]	PAHs[6]	None	#4, 5, & 6 Fuel Oil Bunker C Mineral Oil Virgin Motor Oil Hydraulic Oil
Waste/Used Oil and Unknown Products and Wastes	VOCs[2] PAHs[6] Lead and Lead Scavengers[4]	VOCs[2] PAHs[6] Lead and Lead Scavengers[4]	VOCs[5]	Waste/Used Oil Unknown refined petroleum product or waste

[1] Scope and general guidance – This table is intended for use when investigating refined petroleum releases at regulated UST sites. Consult the IDEM Project manager regarding: 1) laboratory methods based on site-specific needs and cost effectiveness; 2) modification of contaminant reporting once the site characterization is completed; 3) potential petroleum contaminants for products not listed in this table; and 4) additional reporting based on site-specific information.

[2] VOC Methods - During site characterization use SW846 Method 8260B and report all VOCs and naphthalenes. SW846 Method 8021 may be more cost effective during Corrective Action Plan (CAP) Implementation and closure monitoring and should be considered when seeking reimbursement from the Excess Liability Trust Fund (ETLF). Identify which methods are proposed in the CAP.

[3] Naphthalenes – Report naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

[4] Lead and Lead Scavenger Methods – Report total lead and lead scavengers when investigating aviation gas and racing fuel, and when automotive gas was used or stored before January 1, 1996. Lead scavengers include EDB (ethylene dibromide or 1,2-dibromoethane) and 1,2-DCA (1,2-dichloroethane). Use EPA Methods with appropriate detection limits. Ground water samples for lead analysis should be unfiltered.

[5] Air VOC Method – Report all VOCs. Use Method TO-15 for VOC.

[6] PAHs Methods – Report all PAHs. Use SW846 Method 8270 SIM, 8310 or other appropriate method for PAHs.

Potential Petroleum Contaminants **June 21, 2012**

The following sections provide a brief description of each performance indicator selected for the sampling measurement systems. Tables 4 and 5 provide MQO and DQI elements for project field and analytical control standards.

Precision

Precision, usually expressed as a relative percent difference (RPD), is the degree of agreement among repeated measurements of the same characteristic (analyte, parameter, etc.) under the same or similar conditions. Precision data indicate how consistent and reproducible the field sampling or analytical procedures have been. Comparing field and laboratory precision will help to identify sources of imprecision if a problem exists. Poor precision may result from field instrument variation, analytical measurement variation, poor or inappropriate sampling technique, sample transport problems, and/or heterogeneous matrices.

Accuracy (as Bias)

Accuracy usually expressed as a percent recovery (% R), is the extent of agreement between an observed value (sample results) and the accepted, or true, value of the parameter being measured. Analyte accuracy can be evaluated using different types of QC samples, such as a Standard Reference Material (SRM) or Laboratory Control Sample (LCS). Because environmental samples contain interferences (i.e., other compounds that may interfere with the analysis of specific analytes), the accuracy for a specific analyte should be evaluated in relation to the sample matrix. This is done by analyzing matrix spike/matrix spike duplicate (MS/MSD) samples and computing the percent recovery.

Accuracy can be impacted by field sample collection and transport contamination, or by contamination introduced at the time of sample preparation and/or analysis. Sample contamination may result in either negative or positive bias. For example, metals may adsorb on plastic sampling materials. This would result in lower metal concentrations being reported than are actually present in the collected sample (i.e., negative bias).

Representativeness

Representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental conditions of the site. Representativeness also reflects the ability of the sample team to collect samples and laboratory personnel to analyze those samples in such manners that the data generated accurately and precisely reflects the conditions at the site. If field duplicate or co-located precision checks indicate potential spatial variability, then this may trigger additional coordination with IDEM and subsequent resampling in order to collect data that is more representative of a non-homogeneous site.

Completeness

Completeness is a measure of the amount of valid data collected using a measurement system. The percent of completeness is the total number of samples for which acceptable analytical data are generated divided by the total number of samples analyzed and multiplied by one hundred (100). A lack of data completeness may require additional sampling.

Comparability

Comparability is an expression of the confidence with which one set of data can be compared to another as a qualitative measurement. It is a careful identification that two data sets may be equivalent in the measurement of a parameter or set of parameters. It is dependent upon proper sampling design and may be satisfied by ensuring that the field sampling plan is followed, that proper sampling techniques are utilized, that proper analytical methods are established, and proper quality assurance objectives are used and documented.

Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. Sensitivity is determined from the value of the standard deviation at the concentration level (method detection level) of interest. It represents the minimum difference in concentration that can be distinguished between two samples with a high degree of confidence.

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The following tables provide a general program listing of MQO and DQI elements for project field and analytical control standards.

Table 4. Quality Assurance/Quality Control – Soil (SW 846)

QC Sample	Frequency/ Number	Data Quality Indicator (DQI)	Measurement Quality Objective (MQO)	Conclusion
Equipment Blank	1 per sample location when non-disposable sampling equipment used	Effectiveness of field decontamination procedures	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to possible cross-contamination. Field decontamination procedures should be reviewed.
Field Duplicate	1 per 20 samples	Effectiveness of field sampling procedures	≤ 40% Relative Percent Difference (RPD)	All affected data considered biased (High, Low, or Unknown) due to sampling error. Sample collection procedures should be reviewed.
Laboratory Control Sample (LCS)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to laboratory or instrument error.
Internal Std (IS)	Per Method and/or Laboratory SOP	Evaluation of laboratory analysis procedures	% Recovery and Method or Laboratory SOP	All affected data considered estimated (High, Low, or Unknown) due to cross-contamination during transport or storage
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	1 per 20 samples	Evaluation of matrix interferences	≤ 40% RPD, % Recovery as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to Matrix Interference.
Method Blank(MB)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument conditions	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to laboratory or instrument cross-contamination.
Surrogate Spike(SS)	Per Method and/or Laboratory SOP	Evaluation of instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to laboratory or instrument error.

Table 5 Quality Assurance/Quality Control – Groundwater (SW 846)

QC Sample	Frequency/ Number	Data Quality Indicator (DQI)	Measurement Quality Objective (MQO)	Corrective Action if Out of Control
Equipment Blank	1 per sample location when non-disposable sampling equipment used	Effectiveness of field decontamination procedures	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to possible cross-contamination. Field decontamination procedures should be reviewed.
Field Duplicate	1 per 20 samples	Effectiveness of field sampling procedures	≤ 20% RPD	All affected data considered biased (High, Low, or Unknown) due to sampling error. Sample collection procedures should be reviewed.
Laboratory Control Sample (LCS)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to laboratory or instrument error.
Internal Std(IS)	Per Method and/or Laboratory SOP	Evaluation of laboratory analysis procedures	% Recovery and Method or Laboratory SOP	All affected data considered estimated (High, Low, or Unknown) due to cross-contamination during transport or storage
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	1 per 20 samples	Evaluation of matrix interferences	≤ 20% RPD, % Recovery as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to Matrix Interference.
Method Blank(MB)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument conditions	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to laboratory or instrument cross-contamination.
Surrogate Spike(SS)	Per Method and/or Laboratory SOP	Evaluation of instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered estimated (High, Low, or Unknown) due to laboratory or instrument error.
Trip Blank	1 per 20 samples	Evaluation of sample integrity during transport and storage	All analytes < Reporting Limit	All affected data considered estimated (High, Low, or Unknown) due to cross-contamination during transport or storage.

A.6 Special Training/Certification

All reports must be signed by one of the following environmental professionals.

1) Registered Professional Engineer licensed by the State of Indiana;
2) Indiana Licensed Professional Geologist;
3) Certified Hazardous Materials Manager;
4) Indiana Registered Soil Scientist.

A.7 Documentation and Records

A.7.1 IDEM *Investigation of UST Releases QAPP*

The most current, approved version of this QAPP will be available in three places. Owner/operators and their consultants will be able to access the document on the Leaking UST Program Website. (Appendix A, #4) IDEM staff will be able to access the document on the IDEM SharePoint site for the UST Branch, Extranet QA Active QAPPs page, and Leaking UST Program Website. (Appendix A, #4).

A.7.2 Deliverables to UST Program

The UST Branch site files are maintained by the project managers and reports submitted to the agency by UST owners/operators and consultants are available on-line in the Virtual File Cabinet.

B. Data Generation and Acquisition

IDEM does not collect samples for the UST Branch. Liable parties hire their own consultant to collect samples for analysis. Detailed guidance for sampling procedures is located in the IDEM *Remediation Closure Guide* (RCG), 2012 (Appendix A, #3) and state rules 329 IAC 9.

B.1 Sampling Process Design

B.1.1. Rationale for the Design and Design Assumptions

Samples are typically collected from subsurface soil and groundwater media. Samples may also be collected from surface soil (spills or overfills) and surface water when applicable. In addition, soil gas and/or indoor air samples may be collected to assess the vapor intrusion exposure pathway.

IDEM's risk based sampling design is based upon the goal of locating sample points at areas most likely to be impacted by a release from a UST system. Therefore, the design initially includes sampling at the UST pit area, piping runs, and dispenser islands. IDEM does allow flexibility in the selection of sampling points if appropriate justification is provided to the agency from the consultant performing the work (for instance, if the sampling point location is inaccessible). A conceptual site model (CSM) is maintained and updated as new information is available.

The contaminants of concern (COCs) to be included in the analytical suite for petroleum USTs are in four main groups: gasoline, diesel, hydrocarbon oils, and waste oil. Additional information is available on Table 2 and 3.

B.1.2. Procedures for Locating and Selecting Environmental Samples

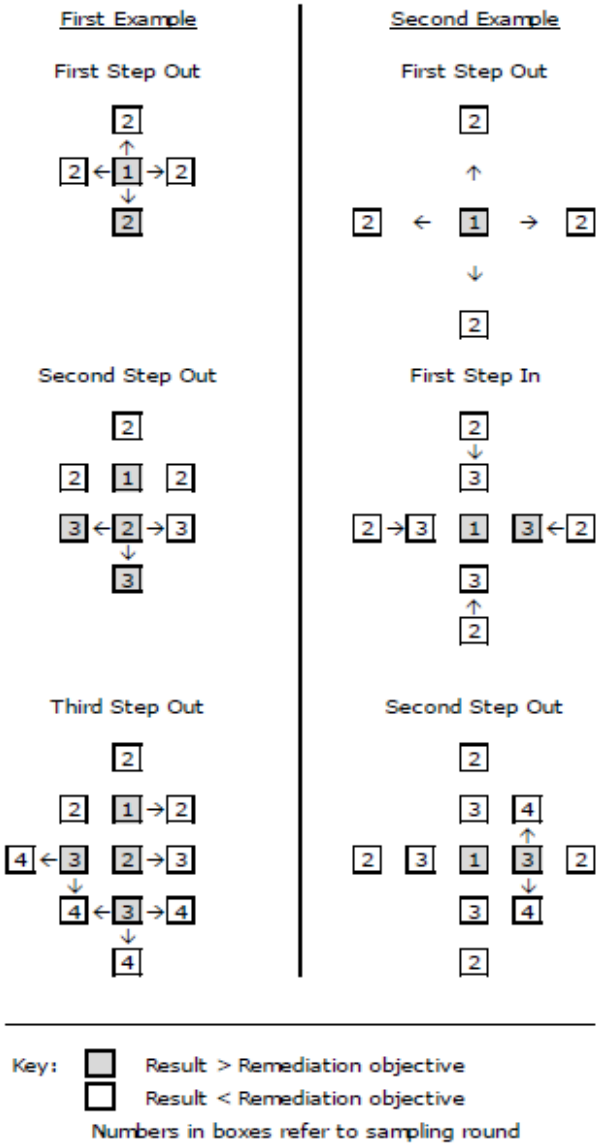
The *Remediation Closure Guide* describes on page 41 Figure 3-A, that horizontal delineation efforts may employ a step-out procedure, as illustrated in Figure 3. In this figure, each box represents a sample location, and the numbers within the boxes correspond to sampling round, so that a box containing a "1" marks the location of a sample collected during the first sampling round, and a box containing a "3" marks the location of a sample collected during the third

sampling round. Shaded boxes represent sample results that significantly exceed the remediation objective.

The step-out procedure investigates each significant unbounded exceedance of the remediation objectives by collecting additional samples in unsampled cardinal directions (i.e., north, east, south, and west). Step-out distances can vary as suggested by site characteristics. The process is iterative, with step-outs surrounding each successive exceedance until the horizontal extent of contamination is delineated.

In some cases, it may be advisable to employ a step-in procedure, as illustrated in the second example of Figure 3. In this example, a bounded exceedance is more tightly bounded using a second set of samples placed closer to the initial exceedance. Step-in procedures may be especially useful when attempting to reduce the size of an area proposed for active remediation or institutional controls (ICs).

Figure 4: Step-in/Step-out Method of Sample Location



Field screening instrumentation such as photoionization detectors (PIDs) or flame-ionization detectors (FIDs) should be used (as applicable for the relevant contaminants) to assist in the selection of soil samples to be submitted for laboratory analysis. Soil samples may also be selected based on obvious signs of contamination. In the absence of positive screening results or visual cues, the samples from borings submitted for laboratory analysis should be from a material within the core interval displaying the greatest apparent effective porosity. Ground water samples should be collected from the initial water-bearing unit.

B.1.3. Validation of Nonstandard Approaches

IDEM Project Management staff must approve all nonstandard sampling or measurement methods in advance. IDEM may request additional data be collected if nonstandard sampling or measurement methods are utilized without prior approval.

B.2 Sampling Methods

Sampling for UST release sites shall be conducted in accordance with IDEM RCG guidance document and state laws 329 IAC 9.

UST Program reports (Table 1) shall include, but not be limited to a description of the sample and data collection procedures followed. IDEM recognizes that deviations to procedures may occur from time to time due to site-specific conditions or due to problems that may occur such as equipment failure. The owner/operator and consultant should have contingency plans in the event that problems such as equipment failure or a need for additional supplies might arise. All deviations and corrective actions should be thoroughly documented.

B.3 Sample Handling and Custody

Proper sample handling and custody procedures found in Section 3.1 of the *Remediation Closure Guide* (Appendix A, #3) are crucial to ensuring the quality and validity of data obtained through field and laboratory analysis. Standard procedures for handling and documenting field samples are important to ensure high-quality, representative samples. A site-specific sampling and analysis plan (SAP) or similar sampling document should describe sample handling and field documentation procedures. IDEM's Office of Land Quality (OLQ) does not currently offer a general guidance document for sample handling, and OLQ does not typically require specific field documentation forms. The admissibility of environmental data as evidence in a court of law is dependent on the custody of the data. The possession and handling of samples should be documented from the time of collection to delivery to the laboratory. A sample is considered in custody if it is:

- In a person's possession;
- In view of the person after being in their possession;
- Sealed in a manner such that it cannot be tampered with after having been in physical possession; or
- In a secure area restricted to authorized personnel.

B 3.1 Owner/Operator and Consultant Sampling Events

All site reports submitted by owner/operator and consultants will be reviewed and the following elements assessed for appropriate sample handling:

- Preservatives;
- Cooler temperature (must be 4 ± 2 ºC);
- Holding times;
- Designation of persons responsible for maintaining field notebooks, sample custody, and sample receipt by the laboratory;
- Project sample tracking system including a unique project numbering system;
- Chain of custody information that includes at a minimum: date and time of collection; number of each type of sample; matrix type; method of preservation; type of analysis; turnaround time; sampler name; and sampler's signature.

All sample containers should be labeled in waterproof ink at the time of sample collection but prior to being filled. Each label will indicate at a minimum:

- Sample identification;
- Date/time of sample collection;
- Sampler's initials;
- Required analyses;
- Type of preservative.

The owner/operator and consultant is responsible for ensuring that samples are packaged and transported in a manner that maintains the integrity of the sample and permits the analysis to be performed within the prescribed holding time. Samples may be shipped by courier or overnight

mail to the laboratory. IDEM recommends the use of bubble-wrap packing materials and ice stored in resealable plastic bags. The cooler should be taped closed using custody seals.

B 3.2 Laboratory Custody

For owner/operator and consultant sampling events, the laboratory utilized must sign the chain of custody when the samples are received. The laboratory verifies that all samples are accounted for and are not broken. The laboratory must store the samples in a secure refrigerated area that maintains the temperature at 4 ± 2 ºC and is responsible for disposal of samples. The laboratory must submit a cooler inspection report (or equivalent) along with the laboratory report.

B.4 Analytical Methods

The selection of potential contaminants to be evaluated depends on the type of petroleum or, in rare instances, hazardous substances stored in the UST system. The typical petroleum categories, the standard target contaminants, and analytical methods for each group are listed in Table 5. In addition, the *Supplemental Guidance for Sampling Soil and Waste Samples for VOCs* technical guidance document (Appendix A, #13) should be consulted for all sites with VOC analysis requirements.

Owner/operator and consultants are responsible for ensuring samples are analyzed within their recommended holding time.

B.5 Quality Control

Quality Control (QC) Activities for Sampling, Analytical or Measurement Techniques
IDEM requires the collection of QA/QC data throughout different stages of the site characterization, corrective action, and closure process. In the event that questions arise during data evaluation, IDEM reserves the right to request full QA/QC documentation from the sampling event and the laboratory utilized.

Control Limits and Corrective Actions

The difference between the reported and actual concentrations of a sample is a function of both sampling and/or field error and/or analytical error. Sampling and/or field error is assessed with field QC samples. The magnitude of analytical error may be assessed by evaluating the laboratory quality control samples.

The SSB Chemist will determine the usability of data. Field sampling activities will be evaluated as a component of the overall data usability. In some cases, data of poor quality may necessitate the collection of new or additional samples.

Precision

Field precision will be assessed through the collection and analysis of field duplicate samples. Groundwater matrix samples can be readily duplicated due to their homogenous nature; conversely, the duplication of soil samples is much more difficult due to their non-homogenous nature. Due to this discrepancy by media type, maximum RPDs of ≤ 20% for groundwater samples and ≤ 40% for soil sample field duplicates will be used as advisory limits for analytes detected at concentrations greater than or equal to five times the quantitation limit.

Accuracy

Accuracy is used to determine systematic or random error of results. The accuracy objectives for quantitative analyses are expressed in part in terms of recovery of surrogate compounds (organic compounds) or recovery of spike analyses (inorganic analyses). For all analytes, the accuracy should be within the recovery ranges listed in the referenced DQO analytical method.

Laboratory precision will be based upon laboratory matrix spike/matrix spike duplicate (MS/MSD) analyses. The criteria for precision are specific to the parameter being measured.

Completeness

For this program the desired goal is at least 90% of samples should yield valid data.

Comparability

Compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols for usability purposes and meeting the MQOs.

Sensitivity

Determine the minimum concentration or attribute that can be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit).

The following tables provide a general program list of DQI elements for project field and analytical control standards. Site-specific criteria may be modified.

Table 6 Quality Assurance/Quality Control – Soil (SW 846)

QC Sample	Frequency/ Number	Data Quality Indicator (DQI)	Measurement Quality Objective (MQO)	Conclusion
Equipment Blank	1 per sample location when non-disposable sampling equipment used	Effectiveness of field decontamination procedures	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to possible cross-contamination. Field decontamination procedures should be reviewed.
Field Duplicate	1 per 20 samples	Effectiveness of field sampling procedures	≤ 40% Relative Percent Difference (RPD)	All affected data considered biased (High, Low, or Unknown) due to sampling error. Sample collection procedures should be reviewed.
Laboratory Control Sample (LCS)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to laboratory or instrument error.
Internal Std (IS)	Per Method and/or Laboratory SOP	Evaluation of laboratory analysis procedures	% Recovery and Method or Laboratory SOP	All affected data considered estimated (High, Low, or Unknown) due to cross-contamination during transport or storage
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	1 per 20 samples	Evaluation of matrix interferences	≤ 40% RPD, % Recovery as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to Matrix Interference.
Method Blank(MB)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument conditions	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to laboratory or instrument cross-contamination.
Surrogate Spike(SS)	Per Method and/or Laboratory SOP	Evaluation of instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to laboratory or instrument error.

Table 7 Quality Assurance/Quality Control – Groundwater (SW 846)

QC Sample	Frequency/ Number	Data Quality Indicator (DQI)	Measurement Quality Objective (MQO)	Corrective Action if Out of Control
Equipment Blank	1 per sample location when non-disposable sampling equipment used	Effectiveness of field decontamination procedures	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to possible cross-contamination. Field decontamination procedures should be reviewed.
Field Duplicate	1 per 20 samples	Effectiveness of field sampling procedures	≤ 20% RPD	All affected data considered biased (High, Low, or Unknown) due to sampling error. Sample collection procedures should be reviewed.
Laboratory Control Sample (LCS)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to laboratory or instrument error.
Internal Std(IS)	Per Method and/or Laboratory SOP	Evaluation of laboratory analysis procedures	% Recovery and Method or Laboratory SOP	All affected data considered estimated (High, Low, or Unknown) due to cross-contamination during transport or storage
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	1 per 20 samples	Evaluation of matrix interferences	≤ 20% RPD, % Recovery as per Method or Laboratory SOP	All affected data considered biased (High, Low, or Unknown) due to Matrix Interference.
Method Blank(MB)	Per Method and/or Laboratory SOP	Evaluation of laboratory and instrument conditions	All analytes < Reporting Limit	All affected data considered biased (High or Unknown) due to laboratory or instrument cross-contamination.
Surrogate Spike(SS)	Per Method and/or Laboratory SOP	Evaluation of instrument capability	% Recovery and % RPD as per Method or Laboratory SOP	All affected data considered estimated (High, Low, or Unknown) due to laboratory or instrument error.
Trip Blank	1 per 20 samples	Evaluation of sample integrity during transport and storage	All analytes < Reporting Limit	All affected data considered estimated (High, Low, or Unknown) due to cross-contamination during transport or storage.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

The owner/operator and consultant are responsible for ensuring that equipment is tested, inspected, calibrated, and maintained. IDEM expects that the owner/operator and consultants have documented standard operating procedures (SOPs) for maintenance and calibration of field and laboratory equipment, although copies of SOPS are not routinely requested as submittals. In the event that questions arise during data evaluation, IDEM reserves the right to request full QA/QC documentation from the sampling event and the laboratory utilized. Faulty sampling protocols or findings of inappropriate use of field equipment may result in requests for corrective action, including the possibility of resampling.

B.7 Instrument/Equipment Calibration and Frequency

B.7.1 Instrument Calibration and Frequency

Instruments used to gather, generate, or measure environmental data will be calibrated and documented in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Trained personnel will operate and calibrate field measurement equipment in accordance with manufacturer's specifications.

B.7.2 Lab Equipment, including Mobile Laboratories

Equipment will be calibrated using reference standards having known relationships to nationally recognized standards or accepted values of physical constants.

B.8 Inspection/Acceptance of Supplies and Consumables

The owner/operator and consultant are responsible for the inspection and acceptance of supplies utilized for investigative purposes.

B.9 Non-direct Measurements

Data from secondary sources, such as: computer modeling, Indiana Department of Natural Resources (DNR) Well logs, topographic map, and sewer maps, must be reviewed and approved by IDEM Science Services Branch technical evaluation staff. Owners/operators and/or consultants are encouraged to contact the IDEM PM for approval prior to utilizing non-direct measurement methods.

B.10 Data Management

B. 10.1 Data Recording

Laboratory Data

When environmental sampling is part of a required report, the report shall present all sample results, including all QA/QC samples. Laboratory data is to be recorded and submitted in accordance with Table 3-A of the *Remediation Closure Guide*. Appendix A, #3

Field Data

The owner/operator consultant field staff will record data such as groundwater elevation data, calibration data, field screening readings, and pilot test results on field forms or in field logbooks. All field records should be signed by the person who performed the analysis or collected the data. This raw data may need to be transferred to computer databases or spreadsheets (e.g., field screening equipment with data download capabilities).

B 10.2 Data Transformation/Data Reduction

Data transformation is conversion of individual data point values into related values or possible symbols using conversion formulas. Data resulting from the analyses of samples should be reduced according to protocols described in the laboratory procedures. This information may include: weight or volume of sample used, percent dry weight for solids, extract volume, dilution

factor used, and background-correction protocols followed. For soil samples, IDEM requests that results be reported on a dry weight basis.

B 10.3 Data Transmittal/Transfer

The current guidance for program documentation submittals may be found on IDEM's Office of Land Quality Document Submittal Guidelines website. Appendix A, #6

B10.4 Data Assessment

The QA review consists of internal and external assessments to ensure that QA/QC procedures are in use and to ensure that laboratory staff conform to these procedures. (EPA Data Quality Assessment: A Reviewer's Guide (QA/G9R) (Appendix A, #19)

B10.5 Data Storage and Retrieval

Records provide the direct evidence and support for the necessary technical interpretations, judgments, and discussions concerning project activities. These records, particularly those that are anticipated to be used as evidentiary data, must directly support technical studies and activities, and provide the historical evidence needed for later reviews and analyses. Records should be legible, identifiable and retrievable, and protected against damage, deterioration, unauthorized modification or loss.

Project related documents (release reports, investigation reports, corrective action plans, quarterly monitoring reports, etc.) that are submitted to or generated by IDEM will be indexed and imported or scanned into IDEM's electronic image storage system, entitled the Virtual File Cabinet (VFC) (https://vfc.idem.in.gov/DocumentSearch.aspx). Documents will be archived in accordance with the applicable retention schedule.

B10.6 Data Security

All data and analytical reports, including QA/QC results, will become part of the project file record and will be retained in the VFC in accordance with the applicable retention schedule (See page 43 of the IDEM QMP, Appendix A, #5).

C. Assessment and Oversight

C.1 Assessments and Response Actions

Assessment of the Program

External Assessments:

- *Semiannual Performance Measures Report*. The UST and LUST Section responsibilities are documented in a cooperative agreement with the U.S. EPA, which provides partial funding for the program through federal funds. The UST and LUST Sections develop an annual work plan, and progress is traced by reporting to the U.S. EPA via the web based "LUST4" database. (https://SSoprod.epa.gov/sso/jsp/oblogin.jsp). Data is later summarized by U.S. EPA and documented in the Semiannual Performance Measures Report (http://www.epa.gov/OUST/cat/camarchv.htm)

Internal Assessments:

- *IDEM Quality System Audits*. The IDEM Quality Managers will perform agency wide quality system audits of each IDEM branch at least once every five years. These audits focus on both agency-wide and branch level quality system components. Details on IDEM quality system audits may be referenced in paragraph 9.1.1 in the *IDEM Quality Management Plan (Appendix A, #5).* Personnel involved in assessment of the UST Branch quality system include the IDEM quality managers, UST Branch management, members of the OLQ quality team, the Science Service Branch QA Coordinator, and technical personnel (e.g., chemists,

geologists, risk assessors). Assessments by non-UST Branch staff such as the IDEM quality managers and by Science Services Branch personnel ensure independence.

- *Periodic Internal Reviews*. From time to time, staff or managers identify strengths or shortcomings of the quality system. Recommendations should be sent to QA staff or supervisors for potential revision. The need for updates to program planning documents, technical guidance and SOPs may be dictated by periodic QA document (QAPP or SOP) review as well as rule changes, technology changes, extramural agreements, or changes in internal practices.
- *Performance Evaluations*. Technical knowledge of all personnel is evaluated annually as a component of individual performance appraisals, and may be addressed at any time if problems arise. Further information about the types of training available for staff may be referenced in the *IDEM Agency wide Quality Management Plan.*

Assessment of Individual Program Activities

Surveillance. The PM is responsible for monitoring the status of a project and reviewing records and reports, ensuring that they meet the requirements of the project. The deficiency and any corrective action shall be noted in writing and a follow-up audit may be completed if deemed necessary by the PM.

Peer Review – Project Mangers. Project manager work products (e.g., reports, memoranda, and correspondence) are subject to review by other PMs, senior environmental managers, or section chiefs. Depending on the nature of the document, the branch chief, assistant commissioner or commissioner may also review it.

Peer Review – Technical Review Staff. At the PM's request, technical staff in the Science Services Branch will perform data quality assessments to confirm that data meets the requested criteria in accordance with the project standards. There is a peer review function within each technical review staff specialty area. Peer reviewers have technical expertise in the subject area, and are not in the management chain of the UST Branch, maintaining independence. A Chemist will perform peer reviews of data QA reviews that are performed by the site chemist.

Field Evaluations. IDEM staff periodically perform field oversight activities to obtain qualitative assessments of environmental data collection activities. The following documents should be considered in the evaluation:

Volatile Organic Compounds in Soil, SW-846 5035A, Appendix A (Appendix A, #12)

Sampling Soil and Waste for Volatile Organic Compounds Technical Guidance Document (Appendix A, #13)

Conceptual Site Model Technical Guidance Document (Appendix A, #14)

Drilling Procedures and Monitoring Well Construction Guidelines Non-rule policy (Appendix A, #15)

The Micro-Purge (Low Flow) Sampling Option Technical Guidance Document (Appendix A, #16)

The Non-Purge Sampling Option Technical Guidance Document (Appendix A, #17)

Groundwater Sampling with Peristaltic Pumps (Appendix A, #18)

Investigation of Manmade Preferential Pathways (Appendix A, #22)

Proper Investigative Techniques for Fractured and Shallow, Non-Karst Bedrock (Appendix A, #23)

Aquitard Characterization (Appendix A, #24)

Vapor Intrusion Investigation Documentation (Appendix A, #25)

Sampling and Analysis of Ground Water for Metals at Remediation Sites (Appendix A, #26)

Polyethylene Diffusion Bag Samplers (Appendix A, #27)

C2. Reports to Management

- *Reports to U.S. EPA*. IDEM reports periodically to the U.S. EPA on LUST program performance, typically referred to as semiannual performance measures. Currently this reporting includes the number of confirmed releases; number of cleanups initiated; number of cleanups completed; and number of emergency responses. Data for this report is currently pulled from the Underground Leaking, Community Right-to-Know, and Emergency Response System (ULCERS) database. In addition, IDEM provides the U.S. EPA with a Financial Status Report.
- *IDEM Quality System Audits*. Audit planning and reporting will involve the participation of the appropriate levels of IDEM management (assistant commissioners and deputy assistant commissioners, branch chiefs, and section chiefs). Those involved in assessment of the UST Branch quality system include: the IDEM quality managers, UST Branch management, members of the OLQ quality team, the Science Service Branch QA Coordinator, and technical personnel. Assessments by non-UST Branch staff, such as the IDEM quality managers and SSB personnel, ensure independence.

  Section chiefs review, and must approve, any documentation regarding the data and any corrective action, such as memoranda, reports, or correspondence. When staff or managers identify program quality issues, they may elevate those issues to the section chiefs; if adequate resolution cannot be achieved at that level, they may subsequently escalate the issue to the branch chiefs and then to the senior management.

D. Data Validation and Usability

D.1 Data Review, Verification, and Validation

Data review is the examination to ensure that the data have been recorded, transmitted and processed correctly. This includes checking for data entry, transcription, calculation reduction, and transformation errors. It also includes ensuring there is a complete list of sample information, such as field documentation, sample matrices, blanks, duplicates, shipping date, preservatives, and holding times.

Data verification evaluates performance against the pre-determined set of specifications; e.g., the sampling design, the analytical method, the appropriate contaminant selection, or other project criteria.

Data validation identifies the quality or the appropriateness of the data set beyond procedural, lab method, or contract compliance criteria to be used to meet the project objective. For example, in the case of a laboratory analysis, the data verification process might identify that spike recoveries fell below project specifications; the validation process would then determine the root cause of the deficiency. Data validation procedures will be performed for both field and laboratory operations. The criteria that will be evaluated are discussed further in D.1.1 through D.1.7.

D1.1 Sampling Design

The UST Program utilizes a judgmental ‘step out’ sampling design, as described in section 3.7 of the *Remediation Closure Guide*. Any subsequent changes in the sampling design should be documented and are reviewed to ensure that adequate decision data is available.

The PM and technical reviewers should check for compliance to the sampling design, or for adequate documentation and justification when the sampling design has been modified.

D1.2 Sample Collection Procedures

Review of the data submittals *(refer to Table 1*) will include a review of whether the appropriate procedures were followed, or whether any necessary variation in the procedures affected the value of the data.

D1.3 Sample Handling

Review of the data will include a review of sample handling. Deviations from approved handling practices, such as the length of the holding time or storage temperature are typically noted by the assigned SSB chemist and noted in the technical review memorandum.

D1.4 Analytical Procedures

Each sample will be verified to ensure that the procedures used to generate the data were implemented as specified and that the results met expected project parameters. Data validation activities will be used to evaluate the potential effects of any deficiencies. (See Section 3.9.1 of the RCG)

D1.5 Quality Control

QC checks that are to be performed during sample collection, handling, and analysis are specified in Sections B4 and B5. During data validation, the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data will be documented.

D1.6 Calibration

Field and laboratory instrument calibration information will be evaluated to ensure that calibrations were performed.

D1.7 Data Reduction and Processing

SSB chemists will provide checks on data. These checks will include checks where duplicate rekeying of data may have resulted in data entry errors. In order to avoid IDEM review staff rekeying errors, chemistry staff have been advised to not re-tabulate sample results in technical review memoranda.

D.2 Verification and Validation

Verification assesses field data by reviewing field records (e.g., screening results, field equipment, monitoring well diagrams, and soil boring logs), chain of custody records, IDEM Initial Site Characterization Checklist, and laboratory analytical results packages. Reports will be checked to ensure field work was documented. (e.g., Initial Site Characterization Checklist, FSI Report Cover Sheet and Report Format, etc.) The laboratory data will be verified in respect to the contaminant, units of measure, and citation of analytical methods, including method and method criteria.

Examples of deviations include sample relocation due to access issues, low soil recovery from a boring, dry wells, or analytical error. In some cases, the verification process may reveal the presence of data gaps.

For UST Release sites, minimum data documentation requirements (MDDR) lab data is sufficient for most sampling information. However, IDEM staff may site specifically request the full QA/QC data package on a site specific basis if necessary.

Validation is an analyte specific and method specific process that compares data quality (i.e., accuracy and precision) against quality criteria predetermined during the planning phase. Validation demonstrates whether the data are reliable enough to meet project objectives.

D.3 Reconciliation with User Requirements

The chemist will conduct a data quality assessment (DQA) to determine whether data are of the correct type, quality, and quantity to support environmental decision making for each project. When any of the project-required measurement performance criteria are not met, then the chemist will document the evaluation in a memorandum to the PM which will address:

1. The specific nature of the problem with the data;
2. The probable source of the error;
3. The potential impact of the error on the usability of the data.

The PM will meet with chemistry staff as needed to discuss the significance of the problem(s), and will write correspondence to the owner/operator that documents the agency's official decision including:

1. A summary of problems (if present);
2. The potential need for corrective action.
3. Recommendations for further actions based on program goals, which may include resampling if data is determined to be unusable.

PMs and chemistry staff should estimate the potential effect that each deviation or deficiency may have on the usability of the associated data item and its contribution to the quality of the reduced and analyzed data. All SSB technical review memoranda and program correspondence generated in the data review, verification, and validation process will be retained in the project file. The official agency decision record is publicly available via the public interface to the electronic filing system, the Virtual File Cabinet (VFC), discussed in section B.10.

The analytical laboratory results submitted by the owner/operator and/or consultant's chosen laboratory for each investigative phase and site activities will change the CSM as understanding of the site improves. Each of these documents are submitted, reviewed and stored in the VFC to assist in the development of the CSM.

A. APPENDIX A

REFERENCES

1	U.S. EPA 2008, Quality Policy, Chief Information Officer 2106.0
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2	U.S. EPA Subtitle I of the Resource Conservation and Recovery Act (RCRA)
	https://www.epa.gov/rcra/resource-conservation-and-recovery-act-rcra-overview
3	IDEM 2012. *Remediation Closure Guide*
	http://www.in.gov/idem/cleanups/files/remediation_closure_guide.pdf
4	IDEM Leaking Underground Storage Tank Website
	http://www.in.gov/idem/tanks/2333.htm
5	IDEM 2018. *IDEM Agency-Wide Quality Management Plan*
	http://www.in.gov/idem/5158.htm
6	IDEM Office of Land Quality Document Submittal Guidelines
	http://www.in.gov/idem/6578.htm
7	U.S. EPA 2002. *EPA Guidance for Quality Assurance Plans,* U.S. EPA QA/G5, EPA/240/R-02/009.
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8	U.S. EPA 2001. *EPA Requirements for Quality Assurance Plans,* U.S. EPA QA/R5, EPA/240/B-01/003.
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9	EPA Final Approval of IDEM Underground Storage Tank Program
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10	Indiana UST Statutes 13-23
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11	Indiana UST Rules 329 IAC 9
	http://www.in.gov/legislative/iac/T03290/A00090.PDF
12	Volatile Organic Compounds in Soil, SW-846 5035A
	https://www.epa.gov/sites/production/files/2015-12/documents/5035a_r1.pdf
13	Sampling Soil and Waste for Volatile Organic Compounds Technical Guidance Document
	https://www.in.gov/idem/cleanups/files/guidance_soil_sampling_vocs.pdf
14	Conceptual Site Model Technical Guidance Document
	https://www.in.gov/idem/cleanups/files/remediation_tech_guidance_conceptual_site_model.pdf
15	Drilling Procedures and Monitoring Well Construction Guidelines Non-rule policy
	https://www.in.gov/idem/ctap/files/nrpd_waste-0053.pdf
16	The Micro-Purge (Low Flow) Sampling Option Technical Guidance Document
	https://www.in.gov/idem/cleanups/files/guidance_sampling_micro-purge.pdf

17	The Non-Purge Sampling Option Technical Guidance Document
	https://www.in.gov/idem/cleanups/files/guidance_sampling_non-purge.pdf
18	Groundwater Sampling with Peristaltic Pumps
	https://www.in.gov/idem/cleanups/files/remediation_tech_guidance_peristaltic_pump.pdf
19	EPA Data Quality Assessment: A Reviewer's Guide QA/G-9R
	https://www.epa.gov/sites/production/files/2015-08/documents/g9r-final.pdf
20	US EPA's Guidance on Systematic Planning Using the Data Quality Objectives Process EPA/QA-G-4
	https://www.epa.gov/sites/production/files/2015-06/documents/g4-final.pdf
21	US EPA's Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model, EPA 542-F11-011
	https://www.epa.gov/remedytech/environmental-cleanup-best-management-practices-effective-use-project-life-cycle
22	*Investigation of Manmade Preferential Pathways*
	https://www.in.gov/idem/cleanups/files/remediation_tech_guidance_investigation_mpp.pdf
23	*Proper Investigative Techniques for Fractured and Shallow, Non-Karst Bedrock*
	https://www.in.gov/idem/cleanups/files/remediation_tech_guidance_shallow_bedrock.pdf
24	*Aquitard Characterization*
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25	*Vapor Intrusion Investigation Documentation*
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26	*Sampling and Analysis of Ground Water for Metals at Remediation Sites*
	https://www.in.gov/idem/ctap/2496.htm
27	*Polyethylene Diffusion Bag Samplers*
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B. APPENDIX B

LIST OF ACRONYMS

CSM	Conceptual Site Model
COC	Contaminant of Concern
DQO	Data Quality Objective
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectroscopy
EPA	U.S. Environmental Protection Agency
IAC	Indiana Administrative Code
IC	Initial Calibration
IDEM	Indiana Department of Environmental Management
LUST	Leaking Underground Storage Tank
MDDR	Minimum Data Documentation Requirement
MS/MSD	Matrix Spike / Matrix Spike Duplicate
OLQ	IDEM Office of Land Quality
PAH	Polycyclic Aromatic Hydrocarbons
PM	IDEM Project Manager
QA	Quality Assurance
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Program Plan
RCG	IDEM Remediation Closure Guide
RCRA	EPA Resource Conservation and Recovery Act
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SC	IDEM Section Chief
SOP	Standard Operating Procedure
VOC	Volatile Organic Compounds
SSB	IDEM Science Services Branch
UST	Underground Storage Tank